

MK-UNet: Multi-kernel Lightweight CNN for Medical Image Segmentation

Supplementary Material

6.1. Analysis of the number of channels

We conduct an ablation study with the different number of channel dimensions in different stages of the network to show the scalability of our network. Table 6 reports the results of this set of experiments. The progression from MK-UNet-T to MK-UNet-L in Table 6 demonstrates a clear positive correlation between model complexity and performance. Starting with MK-UNet-T’s minimal resource use (0.027M #Params, 0.062G #FLOPs) yielding a 75.64% DICE score on BUSI, the score increases to 78.04% with MK-UNet’s moderate complexity (0.316M #Params, 0.314G #FLOPs), and peaks at 79.02% with MK-UNet-L’s higher resource demand (3.76M #Params, 3.19G #FLOPs). This trend of increasing DICE score with model complexity is consistent across datasets.

6.2. Effectiveness of our Grouped Attention Gate (GAG) over Attention Gate (AG) [26]

Table 7 reports the results of the original AG of Attention UNet [26] and our proposed GAG block. It can be seen from the table that our GAG surpasses AG in all datasets with 0.01M fewer #Params and 0.06G less #FLOPs. The use of group convolutions with a relatively larger kernel (3) contributes to these performance improvements with less computational costs.

Network	C1	C2	C3	C4	C5	#Params	#FLOPs	BUSI	Clinic	Colon	ISIC18	DSB18	EM
MK-UNet-T	4	8	16	24	32	0.027M	0.062G	75.64	91.26	85.03	88.19	92.38	94.69
MK-UNet-S	8	16	32	48	80	0.093M	0.125G	77.26	92.31	88.78	88.57	92.45	95.22
MK-UNet	16	32	64	96	160	0.316M	0.314G	78.04	93.48	90.01	88.74	92.71	95.52
MK-UNet-M	32	64	128	192	320	1.15M	0.951G	78.27	93.67	90.27	89.08	92.74	95.62
MK-UNet-L	64	128	256	384	512	3.76M	3.19G	79.02	93.85	91.82	89.25	92.80	95.67

Table 6. Analysis of the number of channels on different datasets. #FLOPs are reported for 256×256 inputs. We report the DICE scores (%) averaging over five runs, thus having 1-4% standard deviations.

Blocks	#Params	#FLOPs	BUSI	Clinic	Colon	ISIC18	DSB18	EM
AG	0.326M	0.320G	77.61	93.02	89.78	88.38	92.48	95.31
GAG (Ours)	0.316M	0.314G	78.04	93.48	90.01	88.64	92.71	95.52

Table 7. Original Attention Gate (AG) [34] vs our Grouped Attention Gate (GAG) with #channels = [16, 32, 64, 96, 160] in MK-UNet. We use the kernel size of 3 for GAG. We report the DICE scores (%) averaging over five runs. Best results are shown in bold.